

# Global Water and Energy Budgets

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**Project hypothesis** Available GEWEX and other global datasets, atmospheric reanalyses, and global land data assimilation data sets can be used to assess the current uncertainty in our knowledge of the global water and energy cycle.

## Objectives & deliverables:

- The goal of this effort is to develop a comparison of water and energy budgets over global land regions in general with a focus on the GEWEX CSEs in particular. We will subsequently move toward ocean and global comparisons.
- This comparison will involve a number of observationally based (GEWEX) water and energy budget processes and variables and corresponding processes and variables from global reanalyses and GLDAS (and GWSP).
- This comparison will provide an overall assessment of the accuracy to which we can quantitatively characterize bulk water and energy cycle processes including understanding their potential error (“closure”).

# Water and Energy Budgets over Land

## Atmospheric Water

$$\frac{\partial Q}{\partial t} = E - P + MC$$

## Surface Water

$$\frac{\partial W}{\partial t} = P - E - N$$

## Total Water

$$\frac{\partial Q}{\partial t} + \frac{\partial W}{\partial t} = MC - N$$

## Atmos. Energy (Dry Static Energy)

$$C_p \frac{\partial \{T\}}{\partial t} = LP + SH + HC + QR$$

## Surface Energy

$$C_g \frac{\partial \{T_g\}}{\partial t} = -LE - L_f SM - SH + G + QRS$$

## Total Energy

$$\frac{\partial (C_p \{T\} + C_g \{T_g\} + LQ)}{\partial t} = (LMC - L_f SM) + HC + G - NR^0$$

# GEWEX and other global data sets (1986-1995, time period of ISLSCP)

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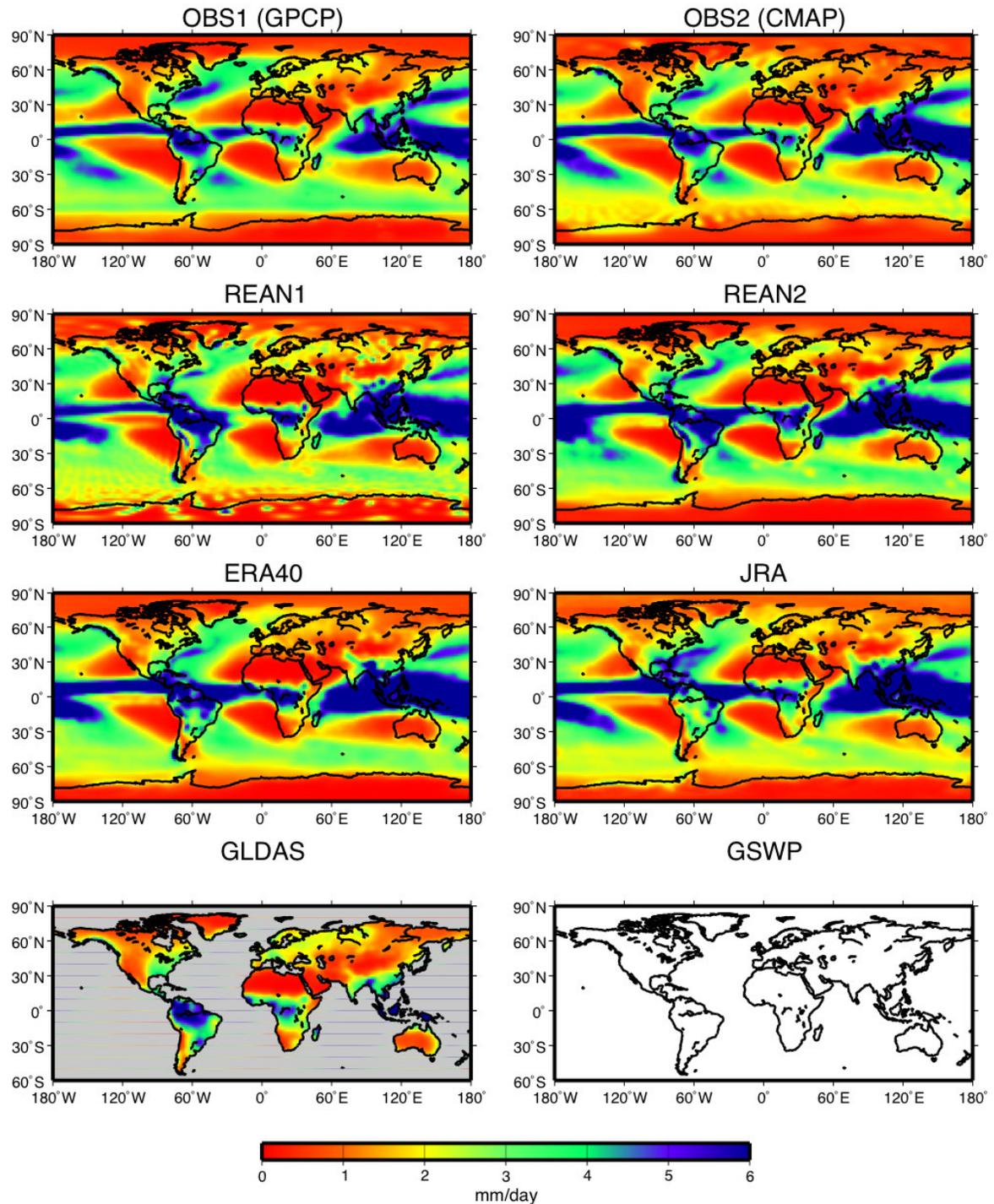
- ◆ **NVAP and ISCCP water vapor**
- ◆ **GPCP and CMAP precipitation**
- ◆ **SRB and ISCCP radiation**
  
- ◆ **GRDC based water balance model runoff, 2 products**
- ◆ **GLDAS and GSWP surface processes and variables**
  
- ◆ **Atmos. Rean.: NCEP RI and RII, ERA40, JRA, (MERRA?)**
  
- ◆ **CSE data sets and regional analyses (CEOP!)**
  - CSE gridded data sets not really available from most CSEs, most rely on global gridded observations and global reanalyses, although there are a few locally gridded obs. and reanalysis sets.
  - CSE in situ measurements have only been globally organized during CEOP (+2001) but these and other in situ measurements (ie BSRN) may provide anchor points for the various gridded products. However, the time lines for this data does not match most of the global data sets.

# Precip. Ann. Mean (86-95)

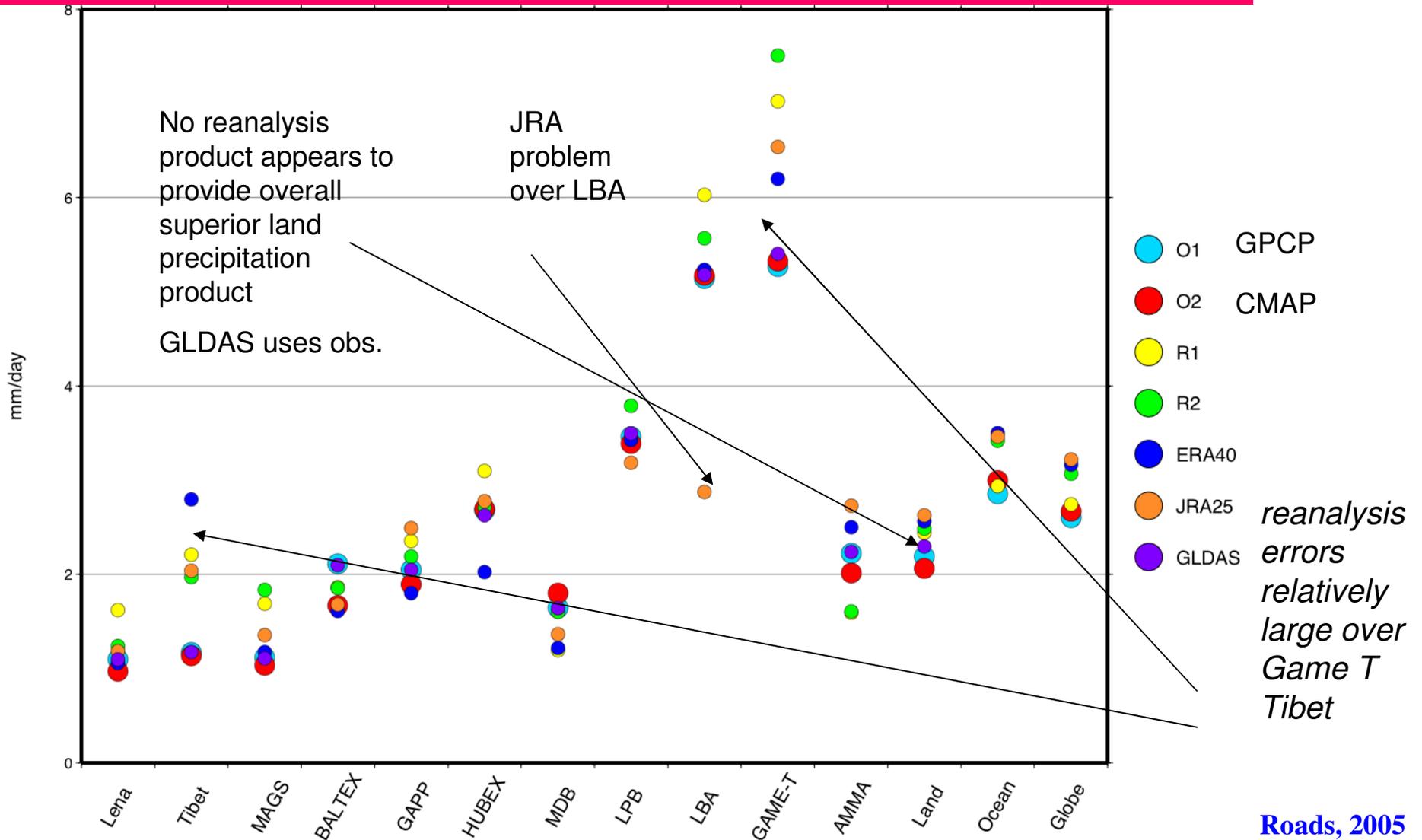
Some differences  
between obs in  
high latitudes

R1 spectral noise  
R2 tropical bias  
ERA tropical bias  
JRA LBA bias

GLDAS uses  
GPCP  
normalization

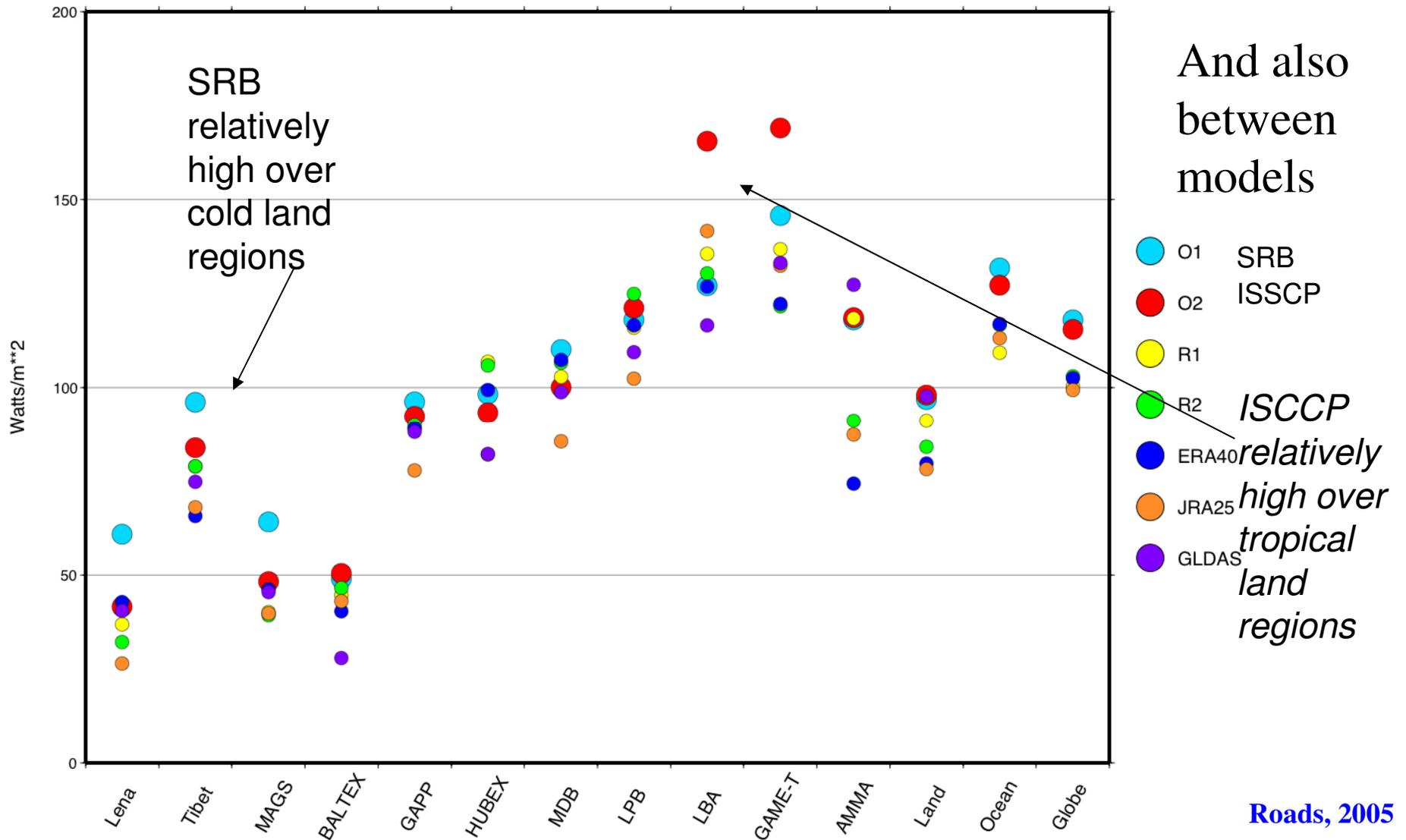


# Precipitation Annual Means 1986-1995



# Sfc. Rad. heating Annual Means 1986-1995

Fairly large differences between obs.



**Data set needs** (particularly large data sets – include potential sizes): **Again for 1986-1995, monthly means, 1-2 deg., ~300MB?**

- Global Observations (SRB, ISCCP, NVAP, GPCP, CMAP)
- Rean. (NCEP/NCAR, NCEP/DOE, ERA40, JRA, MERRA?)
- GLDAS
- GSWP

**Project outputs** (project results that may be made available to the NEWS team for subsequent use – include potential size/resource requirements): **monthly means, 2 deg., 300 MB?**

- Monthly means of ~20 variables and processes for period - 1986 to 1995+
- Assessments of Annual, Seasonal, Interannual means and differences of variables and processes in the various data sets
- Assessment of current closure (or potential errors)

## **Potential collaborations** (with NSIT, other NEWS projects, etc.) :

- Rossow POC
- GLDAS, GMAO
- Other projects comparing different water and energy processes, especially those computing transports from satellite measurements although those projects are currently ocean based
- Ocean surface fluxes, (eventually)

## **Important outside linkages/resources** (outside the NEWS team) :

- GEWEX/GRP, ISCCP, SRB, GPCP
- GEWEX/GMPP, GSWP
- GEWEX/GHP, WEBS
- CEOP, WESP

## **Expected contribution to the NEWS objective:**

- Provide assessment of current uncertainty in closing water and energy budgets over land
- Begin assessment of uncertainty in closing water and energy budgets globally (initially include available ocean components, ie sensible and latent heat fluxes and later ocean dynamical fluxes)

## **Issues, needs, and concerns** (to be discussed in breakouts, teaming discussions, etc.):

- How to extend the chosen time period of 1986-1995 to longer time series? Perhaps by calibration of the reanalysis products?
- When do we begin collaboration with ocean community to get ocean dynamical fluxes? Should we just do that as a residual of surface heat fluxes?





**Technical approach and/or methods** (can be supported or explained with 2-3 additional figure pages):

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